# The grassland communities of the footslopes in the northern Orange Free State, South Africa

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A phytosociological analysis of the grassland vegetation of the footslopes of the Heilbron–Lindley–Warden–Villiers area, northern Orange Free State, South Africa, was conducted. Relevés were compiled in 37 stratified random sample plots. A TWINSPAN classification, refined by Braun-Blanquet procedures, revealed six distinct plant communities. A hierarchical classification, plant-ecological description and ordination of the plant communities are presented.

'n Fitososiologiese analise van die grasveld-plantegroei van die voethange van die Heilbron–Lindley–Warden–Villiers gebied, noordelike Oranje-Vrystaat, is onderneem. Relevés is in 37 gestratifiseerde ewekansig gekose monsterpersele saamgestel. 'n TWINSPAN-klassifikasie, verfyn deur Braun-Blanquet-prosedures, het ses duidelik onderskeibare plantgemeenskappe aangetoon. 'n Hiërargiese klassifikasie, plant-ekologiese beskrywing en ordening van die plantgemeenskappe word aangebied.

**Keywords**: Braun-Blanquet classification, Grassland Biome, plant communities, synecology.

## Introduction

The necessity of detailed plant-ecological studies as a basis for sound land-use planning, management, conservation and research is widely recognized (Pentz 1938; Codd 1949; Bayer 1970; Foran *et al.* 1986; Bosch *et al.* 1987). As part of the vegetation mapping and phytosociological synthesis of the western Grassland Biome (Scheepers 1986), this study aims to identify, classify, describe and ecologically interpret the little-known vegetation of the northern Orange Free State.

A broad description of the physical environment and major plant communities of the Heilbron–Lindley–Warden–Villiers area of the northern Orange Free State was presented by Fuls *et al.* (1993a). Subsequently, a more detailed analysis of the respective major plant communities was undertaken (Fuls *et al.* 1993b,c,d). This paper specifically reports on the detailed Braun-Blanquet classification and plant-ecological interpretation of the grassland communities of the footslopes of the study area (terrain unit 4) (Land Type Survey Staff 1984).

## Study area

The study area lies within the western climatic climax Grassland Biome of southern Africa and is situated between 27°45′ and 29°00′ E longitude and 27°00′ and 28°00′ S latitude (Figure 1). The area covers approximately 1 000 000 ha and is situated at an altitude of between 1500 and 1800 m. The study area forms part of the Highveld inland plateau and consists predominantly of smoothly plained or gently rolling land surfaces of the miocene age (Mentis & Huntley 1982). The topography comprises a mosaic of flat to undulating terrain, interspaced by isolated hills and ridges [see Fuls *et al.* (1993a) for a more detailed discussion of the study area]. The footslopes of the study area (terrain unit 4) comprise approximately 15% of the total land surface area.

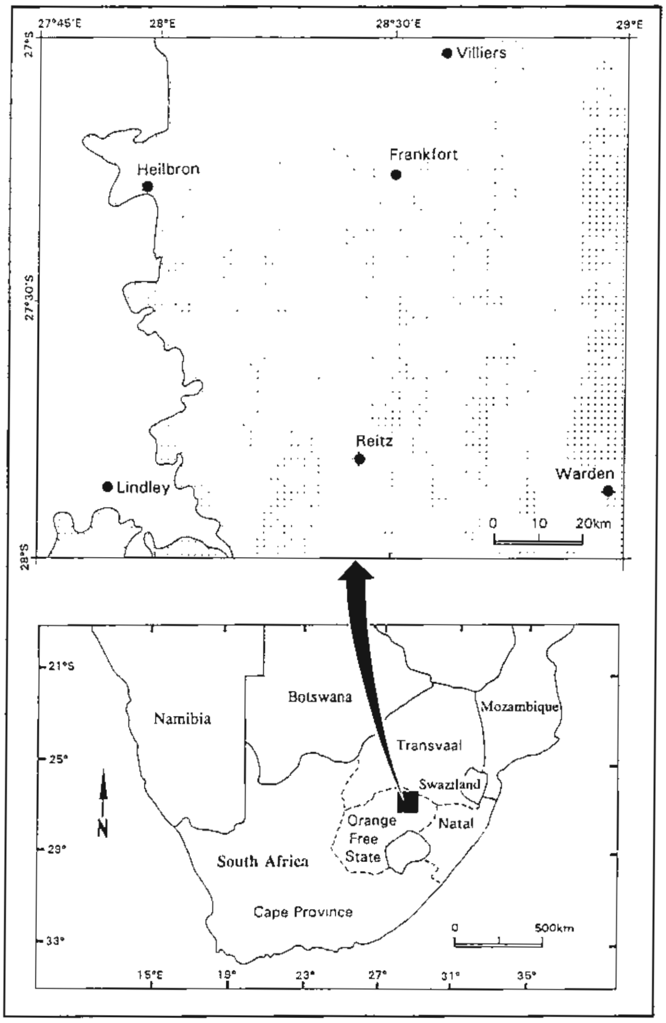

**Figure 1** The study area in which the grassland communities of the footslopes were analysed.

## Methods

Relevés were compiled in 37 stratified random sample plots. Care was taken to restrict sample plots to vegetation in pristine condition wherever possible. Severely degraded stands were avoided. Stratification was based on topographical position [terrain unit — Land Type Survey Staff (1984)], slope and soil. Plot sizes were approximately 10 m × 10 m (Scheepers 1975). In each sample plot, all species were recorded and their respective canopy cover values and/ or abundance recorded, according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974). Taxa names conform to those of Gibbs Russell *et al.* (1985, 1987). Environmental data recorded include geology, topographical position, soil type and depth, sub-soil moisture conditions, soil texture, slope, rockiness of the soil surface, erosion, soil crusting/compaction and utilization by herbivores.

Two-way indicator species analysis (TWINSPAN) (Hill 1979a) was applied to the floristic data set in order to derive a first approximation of the plant communities of the area. Bredenkamp *et al.* (1991) found that TWINSPAN was useful as a first classification of the relevé/species matrix. Refinement of the TWINSPAN classification was done by the application of Braun-Blanquet procedures [see also Bredenkamp *et al.* (1989)]. From the final phytosociological table, six plant communities were identified.

In order to determine and statistically quantify possible vegetation gradients, Detrended Correspondence Analysis (DECORANA) (Hill 1979b) was applied to the floristic data set.

## Results and Discussion

The habitat of the footslopes was found to be markedly homogeneous. Furthermore, the different plant communities could not be related to specific soil types. It was therefore impossible to unequivocally define the diagnostic habitat attributes, location and distribution of the distinctly different plant communities encountered in lowland areas. However, the distribution and composition of the plant communities are apparently strongly linked with soil moisture and/or subsoil moisture, as well as utilization and/or disturbance by livestock (Figure 2). Both these environmental parameters, as well as their influence on the vegetation, cannot be easily quantified. Subsequently, habitat descriptions will be restricted to references to the general soil moisture and utilization regimes encountered within the different plant communities.

The vegetation of the footslopes in the study area can be broadly classified as an *Andropogon appendiculatus – Eragrostis plana* Grassland [see also Fuls *et al.* (1993a)]. This grassland is dominated by medium-sized to large, perennial, tufted graminoids such as *Themeda triandra, Andropogon appendiculatus* and *Cymbopogon plurinodis* (species group J), *Pennisetum sphacelatum* (species group M), *Eragrostis plana* (species group N), and *Eragrostis curvula* (species group O) (Table 1). Collectively these six dominant grass species often comprise more than 80% of the total canopy cover (Table 1). Trees are totally absent from this plant community, with *Stoebe vulgaris* (species group B) being the only conspicuous shrub species occasionally encountered in lowland areas (Table 1). Common forbs include *Anthospermum hispidulum* (species group J), *Cirsium vulgare* (species group M), *Berkheya pinnatifida* and *Senecio erubescens* (species group N), and *Walafrida densiflora, Sonchus dregeanus* and *Senecio inornatus* (species group O) (Table 1).

An average of 25 species per sample plot was recorded, with the total number of species found in the 37 relevés being 160. The relatively low species-richness encountered

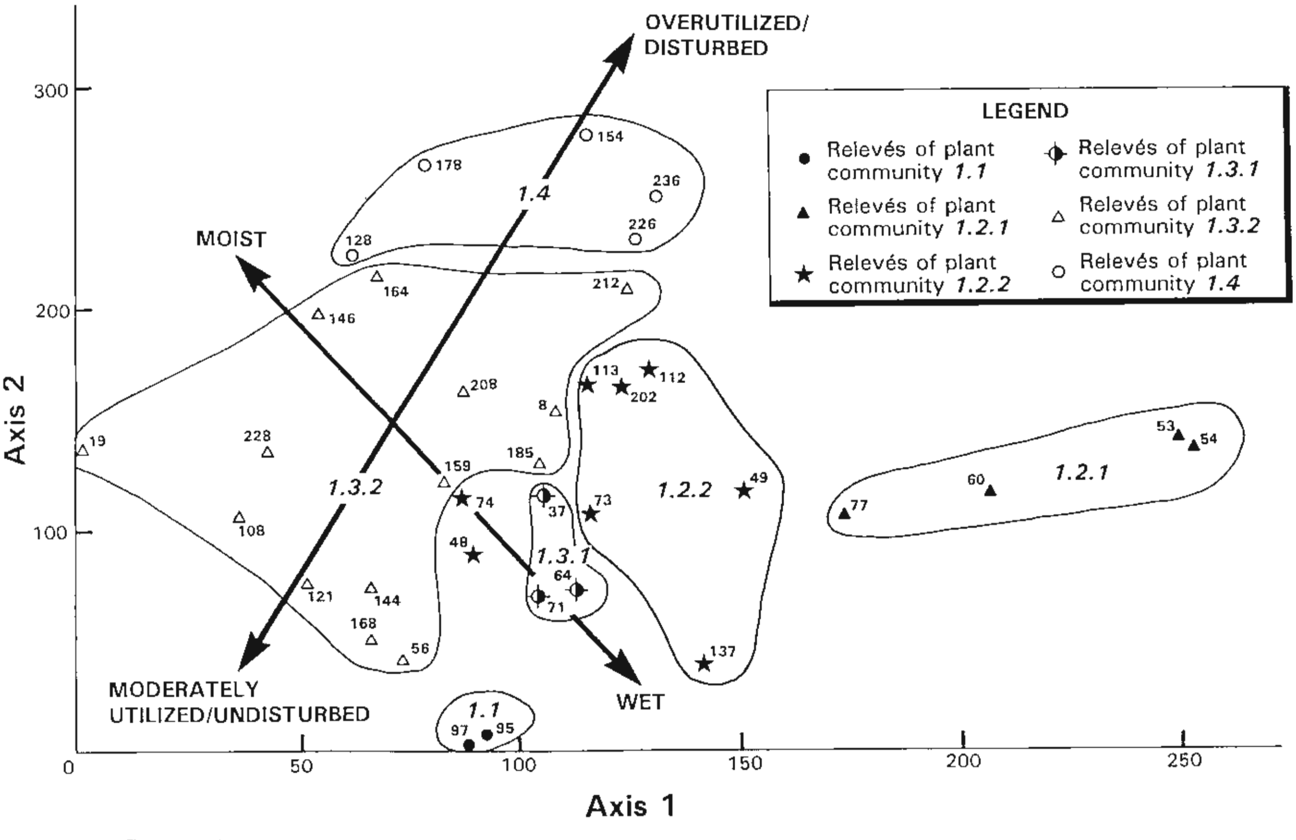

**Figure 2** The DCA ordination of the grassland communities of the footslopes of the study area.

within the grassland communities of the footslopes, if compared to the grassland communities of rocky outcrops, for instance [see Fuls *et al.* (1993c)], is ascribed to the homogeneity in habitat as well as the recorded dominance of a small number of perennial grass species (Table 1).

Six distinct plant communities were identified within the grassland of the footslopes.

## Classification

The hierarchical classification of the six plant communities is as follows:

1. *Andropogon appendiculatus – Eragrostis plana* Grassland
   - 1.1 *Imperata cylindrica – Themeda triandra* Grassland
   - 1.2 *Scirpus burkei – Aristida junciformis* Grassland
     - 1.2.1 *Eragrostis racemosa – Aristida junciformis* Variant
     - 1.2.2 *Hypochoeris radicata – Helictotrichon turgidulum* Variant
   - 1.3 *Setaria nigrirostris – Themeda triandra* Grassland
     - 1.3.1 *Abilgaardia ovata – Themeda triandra* Variant
     - 1.3.2 *Pennisetum sphacelatum – Themeda triandra* Variant
   - 1.4 *Cynodon dactylon – Eragrostis plana* Grassland

## Description of plant communities

The floristics and associated environmental attributes for the respective plant communities of the *Andropogon appendiculatus – Eragrostis plana* Grassland (Table 1) are given below.

### 1.1 *Imperata cylindrica – Themeda triandra* Grassland

Diagnostic species group A; type relevé 95.

This plant community was found to be scarce, being mostly associated with wet, undisturbed areas adjacent to watercourses (Figure 2).

Diagnostic graminoids of this plant community are the perennial, sward-forming, strongly rhizomatous *Imperata cylindrica*, being typically associated with wet areas, and the medium-sized, tufted, perennial *Sporobolus fimbriatus* (species group A, Table 1). Noteworthy is the absence of *Eragrostis plana* from this plant community (species group N, Table 1). Diagnostic forb species include the erect *Helichrysum nudifolium* and *H. dasycephalum*, the decumbent, spreading *Turbina oblongata* as well as the conspicuous, bulbose *Boophane disticha* (species group A, Table 1). An average of 30 species per sample plot was recorded for this plant community.

### 1.2 *Scirpus burkei – Aristida junciformis* Grassland

Diagnostic species group D; type relevé 54.

This plant community is associated with moist to wet and moderately overutilized/disturbed to overutilized/disturbed areas (Figure 2). Although not consistent, this plant community was often associated with the slightly steeper slopes. However, the slopes of the footslope areas were found to be consistently less than 5°.

The diagnostic, small to medium, tufted, perennial grass species *Aristida junciformis* and *Eragrostis gummiflua* are indicative of retrogression, whereas the diagnostic, tufted perennial, graminoid *Harpochloa falx* is characteristically associated with moist to wet areas (species group D, Table 1). Similarly, the frequently encountered but non-diagnostic, perennial, tufted grass species *Helictotrichon turgidulum* (species group E, Table 1) is characteristically associated with wet areas. The large, strongly rhizomatous, tuft-like, diagnostic sedge *Scirpus burkei* (species group E, Table 1) apparently invades, or at least increases in, disturbed, wet areas. No diagnostic forbs were encountered in this grassland community. Species listed under species group G, especially the tufted, perennial grass species *Tristachya leucothrix*, are also somewhat diagnostic for this plant community (Table 1).

Two variants were identified within this plant community.

### 1.2.1 *Eragrostis racemosa – Aristida junciformis* Variant

Diagnostic species group B; type relevé 53.

This plant community is associated with wet, disturbed lowland areas (Figure 2).

*Eragrostis racemosa*, a small, tufted perennial, is the only diagnostic grass species of this plant community (species group B, Table 1). The diagnostic shrub *Stoebe vulgaris* is occasionally encountered in this grassland (species group B, Table 1). Diagnostic forb species include *Asclepias eminens* and *Commelina africana* (species group B, Table 1). Noteworthy is the high constancy of *Heteropogon contortus* and *Eragrostis capensis* in this plant community (species group H, Table 1). An average of 27 species per relevé was recorded for this plant community.

### 1.2.2 *Hypochoeris radicata – Helictotrichon turgidulum* Variant

Diagnostic species group C; type relevé 74.

This plant community is encountered in slightly drier, less disturbed areas than the *Eragrostis racemosa – Aristida junciformis* Variant (Figure 2).

Diagnostic species of this plant community are the medium-sized, tufted, annual graminoid *Bromus catharticus*, the forbs *Hypoxis radula* and *Verbena brasiliensis*, the small succulent *Euphorbia striata* and the sedge *Kyllinga erecta* (species group C, Table 1). This plant community is also differentiated from the *Eragrostis racemosa – Aristida junciformis* Variant by the presence of species listed under species group M in this grassland community (Table 1). An average of 31 species per sample plot was recorded for this plant community.

### 1.3 *Setaria nigrirostris – Themeda triandra* Grassland

Diagnostic species group I; type relevé 144.

The habitat and condition of this plant community was found to be variable, ranging from wet to moist and from moderately utilized and undisturbed to moderately overutilized and disturbed (Figure 2). This plant community is most commonly encountered on the footslopes, probably covering up to 50% of the total footslope land-surface area.

**Table 1** Phytosociological table of the grassland communities of the foot-slopes in the northern Orange Free State

| Community number | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | | 1.2 | | | | | | | | | | | 1.3 | | | | | | | | | | | | | | | | | | | 1.4 | | | | |
| | 1 | | 1 | | | | 1 | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | 1 | | | | |
| | 1 | | 2 | | | | 2 | | | | | | | 3 | | | 3 | | | | | | | | | | | | | | | | 4 | | | | |
| | | | 1 | | | | 2 | | | | | | | 1 | | | 2 | | | | | | | | | | | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 2 |
| Releve number | 9 | 9 | 7 | 6 | 5 | 5 | 7 | 7 | 1 | 1 | 4 | 3 | 4 | 6 | 7 | 3 | 1 | 2 | 6 | 0 | 0 | 5 | 5 | 6 | 2 | 4 | 5 | 8 | 0 | 4 | 0 | 1 | 7 | 2 | 3 | 5 | 2 |
| | 5 | 7 | 7 | 0 | 3 | 4 | 3 | 4 | 2 | 3 | 8 | 7 | 9 | 4 | 1 | 7 | 9 | 1 | 8 | 2 | 8 | 9 | 6 | 4 | 8 | 6 | 6 | 5 | 8 | 4 | 8 | 2 | 8 | 8 | 6 | 4 | 6 |
| Species Group A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Imperata cylindrica | A | A | | | | | | | | | | | | | | | | + | | | | | | | | | | | | | | | | | | | |
| Helichrysum nudifolium | 1 | + | | | | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sporobolus fimbriatus | + | + | | | | | R | + | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Helichrysum dasycephalum | R | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Turbina oblongata | + | R | | | | | | | | | R | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indigofera zeyheri | R | + | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Senecio coronatus | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Boophane disticha | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Species Group B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Eragrostis racemosa | | | A | + | + | + | | | | | R | | R | + | | | | | | | | | | | | | | R | | | | | | | | | |
| Asclepias eminens | | | R | R | R | R | | | | | | | + | R | | | | | | | | | | | | | | | | | | | | | | | |
| Commelina africana | | + | R | R | | R | | R | | | | | | | | | | R | | | | | | | | | | | | | | | | | | | |
| Stoebe vulgaris | | | + | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nidorella anomala | | | + | | | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hibiscus microcarpus | | | R | R | | | | | | | | R | | | | | | | | | | | | | | | | | | | | | | | | | |
| Species Group C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hypochoeris radicata | | | | + | | | + | + | + | | + | | + | | | | | | | | | | | | | | | | | | | | | + | | | |
| Verbena brasiliensis | | | | | | | + | R | + | R | | | | | | | | | | | | + | | | | | | | | | | | | + | | | |
| Euphorbia striata | | R | | | | R | R | R | | R | | R | | | R | | | | | | | R | | | | | | | | R [no] | | | | | | | |
| Kyllinga erecta | | | | | | | | | 1 | + | + | | | | | | | | | | | | | | | | | | | | | | | | | + | |
| Bromus catharticus | | | | | | | R | + | | | + | | | | | | | | | | | | | | | | | | | | | | | | R | | |
| Species Group D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aristida junciformis | | | A | A | 3 | 3 | + | + | | + | + | R | + | + | | | | | | | | | | | | | | | | | | R | | | | | | |
| Scirpus burkei | | | R | + | A | 1 | R | | 1 | + | | | R | | | | | | | | | | | | | | | | | | | | | | | | |
| Harpochloa falx | | | | + | A | + | | + | | | R | + | | | | | | | | | | | | | | | | | | | | | | | | | |
| Eragrostis gummiflua | | | R | R | | | | | R | | | | R | | | | | | | | | | | | | | | | | | | | | | | | |
| Species Group E | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Setaria sphacelata | A | A | + | + | + | + | + | R | A | + | + | + | A | + | R | | | | | R | + | | | + | | | + | | | | R | + | | | + | 1 | + |
| Helichrysum rugulosum | + | + | + | + | | + | + | | + | + | 1 | + | 1 | | | + | R | | | | | | | + | | | 1 | | + | | | | | | | | R |
| Helictotrichon turgidulum | + | | R | + | + | + | R | + | + | + | + | + | + | + | | R | | R | | + | | | | | | | + | | + | | | | | 1 | | | |
| Crabbea acaulis | R | + | + | | | | | R | | R | | | + | | | | | | | | | | | + | | | | | | | | | | | | | R |
| Species Group F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Abildgaardia ovata | | | | | | | | | | | | | | + | R | 1 | + | | | | | | | | | | | | | | | | | | | | |
| Polygala hottentotta | | | | | | | | | | | | + | | R | | R | | | | | | | | | | | | | | | | | | | | | |
| Cymbopogon excavatus | | | | | | | | | | | | | | | | + | | | | | | | | | | | | | | | | | | | | | |
| Senecio polyodon | | | | | | | | | | | | | | | | + | | | | | | | | | | | | | | | | | | | | | |
| Species Group G | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Elionurus muticus | | | + | A | R | | | R | | + | | B | + | R | A | R | | | | | | | | | | | + | | R | | | | | | | | |
| Tristachya leucothrix | | | | + | A | B | | + | | | | R | R | R | | | | | | | | | | | | | | | | | | | | | | | |
| Oenothera stricta | | | R | | | | R | + | | | R | R | | R | R | | | R | | | | | | | R | | | | | | | | | R | | | |
| Hermannia depressa | | | + | + | | | + | R | | | | | | | + | | | | | | | | | | | | | | | | | | | | | | |
| Oenothera rosea | | | | R | | | | | R | R | | | | R | | R | | | | | | R | | | | | | | | | | | | + | | | |
| Helichrysum coriaceum | | | R | | | 1 | | | | | + | | | R | | | | | | | | | | | | | | | | | | | | | | | |
| Species Group H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heteropogon contortus | + | + | + | A | + | + | | | | R | | + | A | + | R | | | R | | | | | | | | | R | | | | | | | | | | |
| Eragrostis capensis | R | + | 1 | A | + | + | | R | | | | | + | + | + | + | | | | | | | | | | | | | + | | | | | | | | R |
| Species Group I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Setaria nigrirostris | | | | | | | | | A | | | + | | + | R | | B | R | A | + | | + | R | A | | B | | + | | B | | A | | | | | |
| Geigeria aspera | | | | | | | | | | | | + | | + | + | | + | | + | R | + | R | | | | | | + | + | | + | + | | | | | |
| Sutera aurantiaca | | | | | | | | | R | R | | | | + | R | + | | | | + | | | R | | | | R | + | | | R | | | R | | | |
| Salvia runcinata | | | | | | | | | | R | | | | R | R | | + | + | | | | R | | | | | R | | R | | | | | | | | |
| Scabiosa columbaria | | | | | | | | | | | | | | R | + | + | | | R | | | | | R | R | R | | | | | | | | | | | |
| Arctotis arctotoides | | | | | | | | | | | | | | + | R | | | R | | | | | | R | R | | | | | | R | R | | | | | + |
| Aristida bipartita | | | | | | | | | | | | | | | A | | B | A | | + | | | R | | | | | | | | | | | | | | R |
| Helichrysum pilosellum | | | | | | | | | | | + | | | R | R | | | R | | | | | | | R | | | + | | | | | | | | | |
| Species Group J | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Themeda triandra | 4 | 4 | 3 | B | B | B | 3 | 3 | + | B | 3 | 3 | 3 | 4 | 3 | 4 | B | 4 | 4 | B | 3 | B | R | A | B | A | 5 | 3 | 3 | 3 | 3 | + | | | + | + | A |
| Andropogon appendiculatus | A | A | A | A | A | A | A | B | B | B | B | 3 | R | B | A | + | | + | A | B | | 3 | B | + | B | + | A | + | B | 3 | R | B | + | | | | |
| Cymbopogon plurinodis | + | | R | + | + | | | R | R | A | | R | + | + | + | + | | | + | + | | | | + | | A | | + | | | R | R | | | | | |
| Anthospermum hispidulum | R | R | + | | | | | | R | | | | R | | + | R | R | R | R | | R | | | R | | R | | | + | | + | | | | | | |
| Species Group K | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cynodon dactylon | | | | R | | | | A | | + | | | R | | | | + | | R | | R | + | R | A | 1 | + | | | + | | + | + | A | R | + | B | 1 |
| Panicum stapfianum | | | | | | | | | | A | | | + | | | | | | + | A | A | | | A | + | R | R | A | | | + | + | + | R | A | R | A |
| Falkia oblonga | | | | | | | | | + | | | | | | | | | R | | R | R | 1 | | + | | | | | | | R | + | 1 | | | 1 | |
| Fingerhuthia sesleriiformis | | | | | | | | | | | | | | | | | | | | | | + | 4 | | | A | | | + | | | | A | R | | | |

**Table 1** Continued

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Community number                                          1

                                      1.1     1.2             1.3           1.4

                                      1    1     1     1          1          1
                                      1    2     2     3          3          4
                                           1     2     1          2

                                      00 0000 0011010 000 0112011121011122 11212
Releve number                         99 7655 7711434 673 1260055624580401 72352
                                      57 7034 3423879 417 9182896486658482 88646

Species Group L

Haplocarpha scaposa                  |  |R   |  1    |+++| ++ R+1 +1+ A  R| R  +|
Berkheya radula                      |  |    |   +   |+++|RRA  1 + 1AA11  |++  R|

Species Group M

Pennisetum sphacelatum               |  |    |AA+ B+R| +R|RB++ B+B3+A+5AA |B3+ R|
Cirsium vulgare                      |  |    |RRR   R|   |R  + ++ R+  R   |RRRR |
Conyza podocephala                   |  |    |R  + +R|+  |        R   R++ | +R +|
Paspalum dilatatum                   |  |    |+RRR  R|   | R          +  +| + RR|
Trifolium africanum                  |  |    |   R   |+  | R   RR+      R |+ R  |
Hermannia oblongifolia               |  |R   |R  R 1 |+  |        R     R |  R R|
Cyperus marginatus                   |  |    |   + + | + |         1     1| 1+  |
Stachys hyssopoides                  |  |    |   + R |   |        R 1     | R   |
Ranunculus multifidus                |  |    |  R    |R  |    R         R |+    |

Species Group N

Eragrostis plana                     |  |ABBB|A+33+ B|AA3|BA+33AA3+A B+ 34|33444|
Berkheya pinnatifida                 |  |R+  |  RR   |+RR|++ RR1 +1+  ++R |  + +|
Senecio erubescens                   |  |R+ R|  RR   |   |    +RR+1R  +  R|R   R|
Pseudognaphalium luteo-album         |  |+ R1|  ++   |   |   +  R    R+   |RRR  |

Species Group O

Eragrostis curvula                   |++|B+AA|BAA+AAB|AA+|++RA+A AAB+B  +A|BAAAA|
Walafrida densiflora                 | R|++  |R ++ +R|   | R 1R  ++ +R  R | + ++|
Digitaria eriantha                   |++|  + |+R     |   |    +  + +     R|  RR |
Sonchus dregeanus                    | R|RR  |R R    |  R| R  R    R      | R   |
Senecio inornatus                    |++|    | ++    |   |           + 1  |+    |
Hypoxis rigidula                     |  |   +|    + +|   |  R  R     +    |     |
Hermannia coccocarpa                 |  |R   |   R   |R  |   R      R     |     |
```

Diagnostic grass species are the medium-sized, rhizomatous and tufted, perennial *Setaria nigrirostris* and tufted *Aristida bipartita* (species group I, Table 1). Diagnostic forbs include *Geigeria aspera, Sutera aurantiaca* and *Salvia runcinata* (species group I, Table 1). The forbs *Haplocarpha scaposa* and *Berkheya radula* are also regarded as somewhat diagnostic for this plant community (species group L, Table 1).

Two variants were identified within this plant community.

### 1.3.1 *Abilgaardia ovata – Themeda triandra* Variant

Diagnostic species group P; type relevé 37.

This plant community does not have conspicuously diagnostic species, being rather characterized by the absence of species listed under species groups A – D, and to a lesser extent those of species group E, from this plant community (Table 1). Diagnostic species include the forbs *Abilgaardia ovata* and *Polygala hottentottica* (species group F, Table 1). An average of 34 species per sample plot was recorded for this plant community.

### 1.3.2 *Pennisetum sphacelatum – Setaria nigrirostris* Variant

Type relevé 144.

This plant community does not have a diagnostic species group (Table 1). However, this variant is differentiated from the *Abilgaardia ovata – Themeda triandra* Variant by the absence of species listed under species groups F – H from this variant, as well as the presence of species listed under species group K within this plant community (Table 1). The graminoid *Pennisetum sphacelatum* has a notably high constancy and/or cover within this plant community (species group E, Table 1). An average of 21 species per relevé was recorded for this variant. The low species count per relevé, compared to that of the *Abilgaardia ovata – Themeda triandra* Variant, is ascribed to the collective high canopy cover of the dominant grasses within this plant community (Table 1).

### 1.4 *Cynodon dactylon – Eragrostis plana* Grassland

Type relevé 178.

This plant community is associated with moist, overutilized and disturbed areas (Figure 2).

This grassland does not have a diagnostic species group and is therefore primarily characterized by the absence of species listed under species group J (Table 1). The otherwise common and often dominant grass species, such as *Themeda triandra, Andropogon appendiculatus* and *Cymbopogon plurinodis*, are mostly absent within this plant community (species group J, Table 1). Grass species frequently encountered in this plant community are the stoloniferous and rhizomatous, sward-forming, perennial *Cynodon dactylon* (species group K), and the tufted, perennials *Panicum stapfianum* (species group K), *Eragrostis plana* (species group N) and *Eragrostis curvula* (species group O) (Table 1). The thorny *Cirsium vulgare* is the most commonly encountered forb species within this plant community (species group M, Table 1). An average of 22 species per sample plot was recorded for this plant community.

### Ordination

The distribution of the relevés along the first and second axes of the scatter diagram is shown in Figure 2. The third axis contributed very little to the environmental interpretation of the communities and is therefore not given here. No distinct discontinuity can be observed among the identified plant communities (Figure 2). The plant communities, however, are largely confined to certain areas of the diagram. The axes individually do not represent any environmental gradients, but in combination they represent distinct moisture and utilization/disturbance gradients (as indicated in Figure 2). The scatter diagram confirms the distinct difference between the *Eragrostis racemosa – Aristida junciformis* Variant and the *Hypochoeris radicata – Helictotrichon turgidulum* Variant (Figure 2). To a lesser extent, the scatter diagram also indicates a difference between the *Abilgaardia ovata – Themeda triandra* Variant and the *Pennisetum sphacelatum – Setaria nigrirostris* Variant (Figure 2). The ordination confirms the classification and gives an indication of floristic and associated environmental gradients.

## Concluding remarks

This footslope grassland often has a patchy appearance, with the different plant communities occurring intermittently, often forming a patch-like mosaic. This distribution pattern may be represented on a farm level as well as on a regional scale. This fact, concomitant with the absence of clear habitat parameters for the different plant communities, will hamper the mapping of the described grassland communities on all scales. Nevertheless, all the plant communities described here can be readily distinguished in the field. Subsequently, the presented classification and description of the footslope grassland communities should be used as a basis for future land-use planning, management and conservation of these areas.

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